Amendments to the Claims

1. A method for determining depth-resolved backscatter characteristics of scatterers within a sample, comprising the steps of:

acquiring a plurality of sets of cross-correlation interferogram data using an interferometer having a sample arm with the sample in the sample arm, wherein the sample includes a distribution of scatterers therein, and wherein the acquiring step includes the step of altering the distribution of scatterers within the sample with respect to the sample arm for substantially each acquisition; and

averaging, in the Fourier domain, the cross-correlation interferogram data, thereby revealing backscattering characteristics of the scatterers within the sample.

2. The method of claim 1, wherein the averaging, in the Fourier domain, step includes the steps of:

calculating a transfer function for each set of cross-correlation interferogram data acquired; and

squaring the magnitude of each transfer function; and

averaging the squared magnitudes.

3. The method of claim 2, wherein the transfer function calculating step includes the steps of:

acquiring auto-correlation interferogram data for the interferometer;

generating, from the auto-correlation interferogram data, an auto-power spectrum;

generating, from the set of cross-correlation interferogram data, a cross-power spectrum; and

obtaining a ratio of the cross-power spectrum to the auto-power spectrum.

4. The method of claim 1, wherein the step of altering the distribution of scatterers within the sample with respect to the sample arm includes the step of physically altering the distribution of scatterers within the sample.

5. The method of claim 1, wherein the step of altering the distribution of scatterers within the sample with respect to the sample arm includes the step of repositioning the sample arm.

6. The method of claim 1, further comprising the step of comparing the backscattering characteristics with control data to diagnose abnormalities or disease within the sample.

7. The method of claim 6, further comprising the steps of incorporating a sample probe of the interferometer into an endoscope or surgical instrument, and scanning the endoscope or surgical instrument along a portion of a patient's gastrointestinal tract tissue to diagnose abnormalities or disease within the patient's gastrointestinal tract tissue, wherein the control data includes data corresponding to backscattering characteristics of relatively normal gastrointestinal tract tissue.

8. The method of claim 1, wherein the acquiring cross-correlation interferogram data step or the averaging step includes the step of controlling the depth over which cross-correlation interferogram data is averaged.

9. The method of claim 8, wherein the interferometer includes a reference arm and the controlling step includes the step of limiting a scan length of the reference arm to an area of interest in the sample.

10. The method of claim 8, wherein the controlling step includes the step of windowing the cross-correlation interferogram data to an area of interest in the sample.

11. The method of claim 1, wherein the interferometer includes a reference arm and the method further comprises the step of monitoring reference arm path length, wherein the acquisition step includes the step of compensating for velocity fluctuations detected during the monitoring step.

12. The method of claim 1, further comprising the step of directing an intense pump laser to the sample, whereby the revealed backscattering characteristics will contain features corresponding to inelastic backscattering characteristics of the scatterers within the sample.

13. A method for determining depth-resolved backscatter characteristics of scatterers within a sample, comprising the steps of:

acquiring auto-correlation data from a low-coherence source interferometer, the low-coherence source interferometer including a sample arm;

acquiring multiple cross-correlation data from the low-coherence source interferometer, wherein the low-coherence source interferometer includes a sample in its sample arm;

obtaining an auto-power spectrum for a windowed portion of the auto-correlation data;

obtaining a cross-power spectrum for a windowed portion of each cross-correlation data;

obtaining a transfer function for each cross-correlation data by taking a ratio of the windowed cross-power spectrum to the auto-power spectrum;

squaring each transfer function; and

averaging the magnitude of the squared transfer functions.

14. An optical coherence tomography system comprising:

an interferometer including an optical radiation source and a sample arm, the interferometer generating a plurality of cross-correlation data outputs for a sample in the sample arm; and

a data processing system, operatively coupled to an output of the interferometer, averaging the cross-correlation data outputs, in the Fourier domain, to reveal backscattering characteristics of scatterers within the sample.

15. The optical coherence tomography system of claim 14, further comprising a database containing control data for comparison against the backscattering characteristics of scatterers within the sample.

16. (cancelled)

17. The method of claim 27, said analyzing comprising taking the Fourier transform of the cross-correlation data.

18. The method of claim 17, further comprising obtaining several sets of cross-correlation data, and said taking the Fourier transform comprising taking the Fourier transform of several of said sets, and said analyzing comprising averaging the Fourier transform results.

19. The method of claim 17, further comprising calculating a transfer function for the cross-correlation data using the Fourier transform of auto-correlation data.

20. The method of claim 27, further comprising demodulating the cross-correlation data prior to performing a time-frequency analysis of the cross-correlation data.

21. The method of claim 20, said demodulating comprising using coherent demodulation method.

22. The method of claim 27, further comprising using an interferometer to acquire cross-correlation data, wherein the interferometer includes a reference arm and a sample arm, and controlling the depth over which cross-correlation data is acquired.

23. The method of claim 22, wherein said controlling includes the step of limiting a scan length of the reference arm to an area of interest in the sample.

24. The method of claim 27, further comprising using an interferometer to acquire cross-correlation data, and windowing the cross-correlation data to an area of interest in the sample.

25. The method of claim 27, further comprising using an interferometer to acquire cross-correlation data, wherein the interferometer includes a reference arm and the method further comprises the step of monitoring reference arm path length.

26. The method of claim 25, wherein the acquiring includes the step of compensating for velocity fluctuations detected during the monitoring step.

27. A method for obtaining optical spectroscopic information from cross-correlation data obtained using low coherence interferometry, comprising

analyzing cross-correlation data to extract spectral information about a sample,

said analyzing comprising performing a time-frequency analysis of the cross-correlation data, and

directing an intense pump laser to the sample.

28. The method of claim 27, said directing comprising directing laser energy to the sample such that revealed backscattering characteristics will contain features corresponding to inelastic backscattering characteristics of the scatterers within the sample.

29. The method of claim 16, further comprising directing electromagnetic energy to the sample such that revealed backscattering characteristics will contain features corresponding to inelastic backscattering characteristics of the scatterers within the sample.

30. The method of claim 16, further comprising the step of directing a pump laser to the sample to alter backscattering characteristics of the scatterers within the sample.

31. The method of claim 16, further comprising the step of directing a pump laser to the sample, whereby revealed backscattering characteristics will contain features corresponding to inelastic backscattering characteristics of the scatterers within the sample.

32. The method of claim 16, further comprising the step of directing a pump laser to the sample to alter the spectral characteristics of the sample.

33. The method of claim 16, further comprising altering the spectral characteristics of the sample.

34. The method of claim 33, wherein said altering comprises directing laser energy to the sample.

35. The method of claim 33, wherein said altering comprises effecting stimulated emission.

36. The method of claim 35, further comprising adding external dyes or contrast agents to the sample.

37. The method of claim 33, wherein said altering comprises effecting stimulated Raman scattering.

38. The method of claim 33, further comprising adding external dyes or contrast agents to the sample.

39. The method of claim 33, wherein said altering comprises at least one of stimulated emission, stimulated Raman scattering, coherent anti-Stokes Raman scattering, stimulated Brillouin scattering, stimulated Rayleigh scattering, stimulated Rayleigh-wing scattering, and four-wave mixing.

40. A method for determining depth-resolved backscatter characteristics of scatterers within a sample, comprising the steps of:

acquiring a plurality of sets of cross-correlation interferogram data using an interferometer having a sample arm with the sample in the sample arm, wherein the sample includes a distribution of scatterers therein; and

averaging, in the Fourier domain, the cross-correlation interferogram data, thereby revealing backscattering characteristics of the scatterers within the sample.

41. The method of claim 40, further comprising the step of physically altering the distribution of scatterers within the sample.

42. The method of claim 40, further comprising the step of repositioning the sample arm.

43. The method of claim 40, further comprising the step of comparing the backscattering characteristics with control data to diagnose abnormalities or disease within the sample.

44. The method of claim 43, further comprising the steps of incorporating a sample probe of the interferometer into an endoscope or surgical instrument, and scanning the endoscope or surgical instrument along a portion of a patient's gastrointestinal tract tissue to diagnose abnormalities or disease within the patient's gastrointestinal tract tissue, wherein the control data includes data corresponding to backscattering characteristics of relatively normal gastrointestinal tract tissue.

45. The method of claim 40, wherein the acquiring cross-correlation interferogram data step or the averaging step includes the step of controlling the depth over which cross-correlation interferogram data is averaged.

46. The method of claim 45, wherein the interferometer includes a reference arm and the controlling step includes the step of limiting a scan length of the reference arm to an area of interest in the sample.

47. The method of claim 45, wherein the controlling step includes the step of windowing the cross-correlation interferogram data to an area of interest in the sample.

48. The method of claim 40, wherein the interferometer includes a reference arm and the method further comprises the step of monitoring reference arm path length, wherein the acquisition step includes the step of compensating for velocity fluctuations detected during the monitoring step.

49. The method of claim 40, further comprising the step of directing an intense pump laser to the sample, whereby the revealed backscattering characteristics will contain features corresponding to inelastic backscattering characteristics of the scatterers within the sample.

50. A method of rapidly determining cross-power spectra from cross-correlation data obtained using low coherence interferometry, comprising the steps of

passing the cross-correlation data through a bank of narrow bandpass filters, and using the output from the narrow bandpass filters as a representation or spectral estimation of cross-power spectrum..

51. The method of claim 50, said passing comprising passing demodulated cross-correlation data, and selecting the center frequency of the bank of narrow bandpass filters according to the demodulation frequency.

52. A method for obtaining information concerning a characteristic associated with a sample from cross-correlation data obtained using low coherence interferometry, comprising:

effecting spectral alterations in the sample from which the cross-correlation data is obtained, and

analyzing the cross-correlation data to extract information pertaining to the characteristic associated with the sample.

53. The method of claim 52, further comprising using at least one of dye and contrast agent to enhance said effecting.

54. The method of claim 52, said effecting comprising at least one of using stimulated emission, using stimulated Raman scattering, using coherent anti-Stokes Raman scattering, using stimulated Brillouin scattering, using stimulated Rayleigh scattering, using stimulated Rayleigh-wing scattering, and using four-wave mixing.

55. The method of claim 52, said effecting comprising directing laser energy to the sample.

56. The method of claim 55, said directing of laser energy comprising using a beam splitter to direct both low coherence interferometer light and laser energy to the sample.

57. The method of claim 55, said directing of laser energy comprising using a wavelength division multiplexer to direct both low coherence interferometer light and laser energy to the sample.

58. The method of claim 55, said effecting comprising directing a time varying incident electromagnetic energy input to the sample, and further comprising detecting

light from the sample synchronously with the modulation of the incident electromagnetic energy.

59. The method of claim 55, said effecting comprising directing pulsed incident electromagnetic energy input to the sample, and further comprising detecting light from the sample using gated integration technique.

60. The method of claim 55, said effecting comprising directing pulsed incident electromagnetic energy input to the sample, and further comprising, detecting, in a timed relation to the pulsed incident electromagnetic energy, light from the sample.

61. The method of claim 60, said detecting in a timed relation comprising using gated integration technique.